TES Development at GSFC for the XMS

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X-ray TES development at GSFC

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Principal areas of progress:

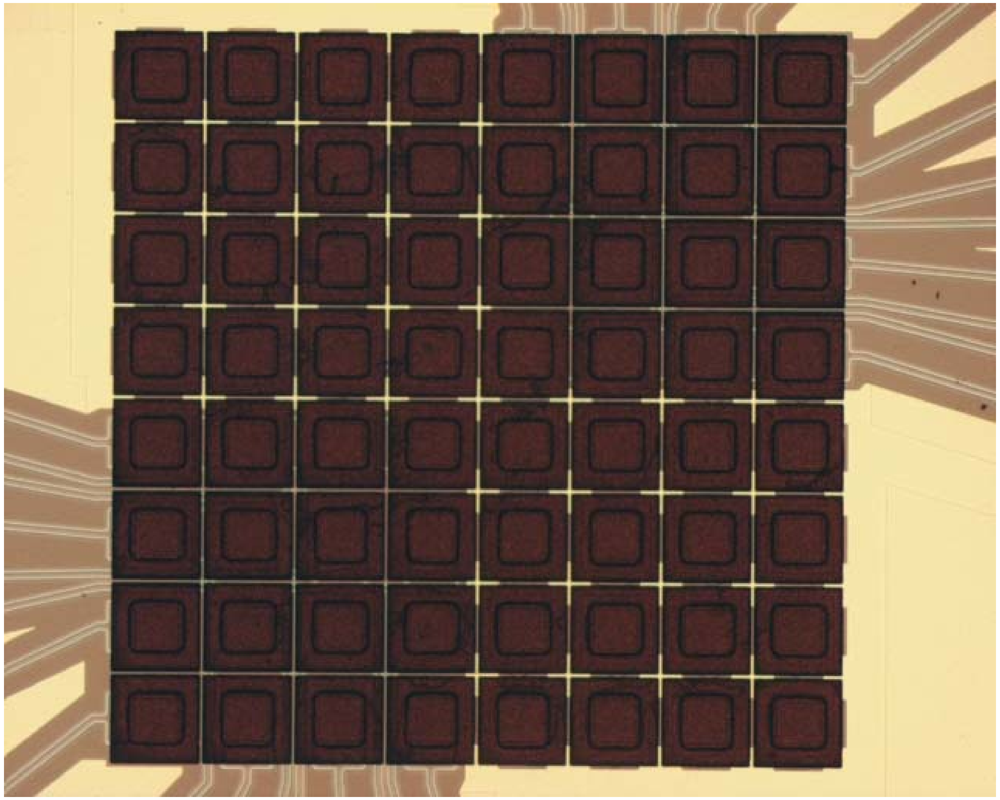
- **fabrication and testing of close-packed 8x8 arrays**
- **absorber characterization and optimization**

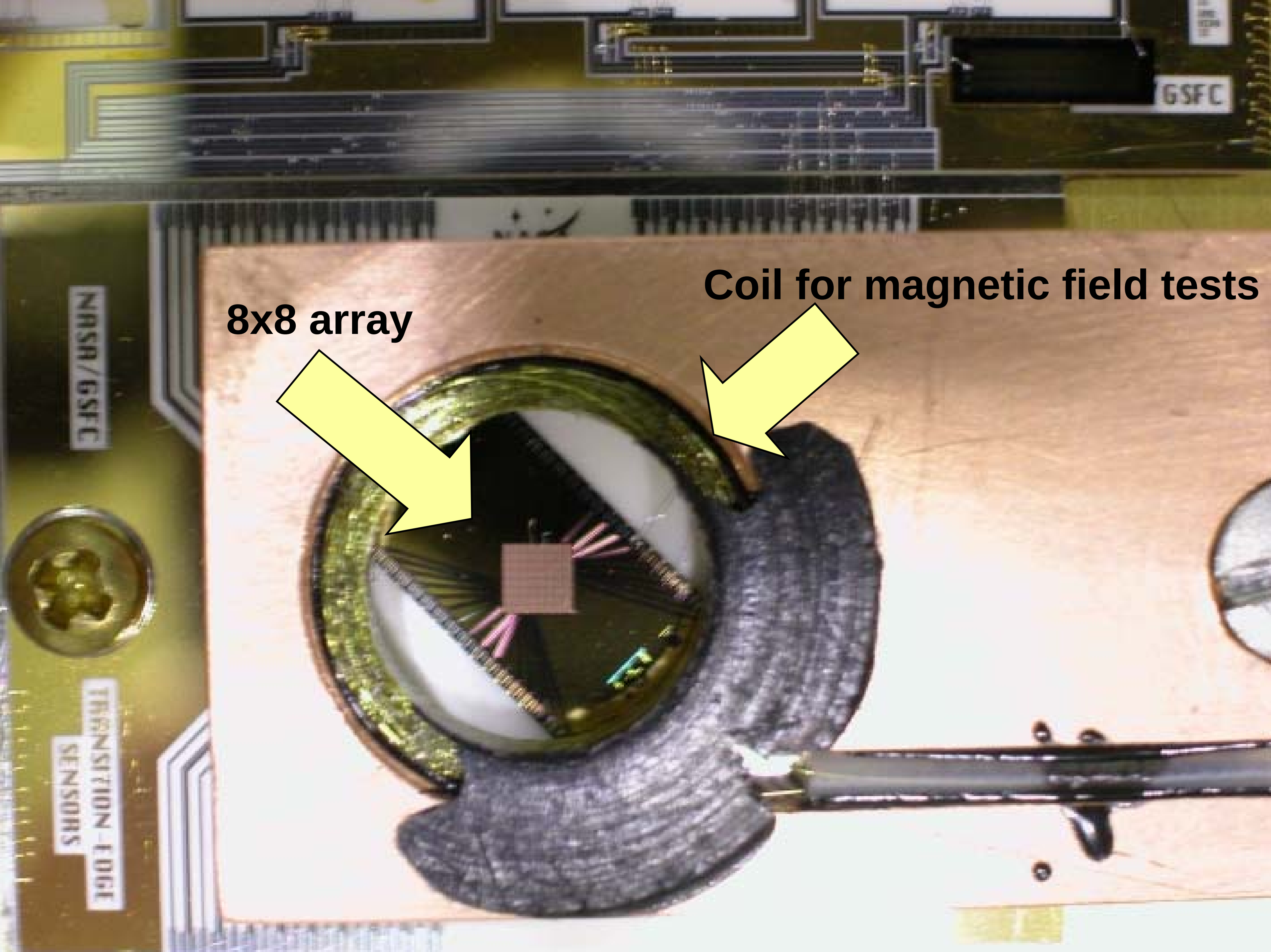
Additional work:

- **noise characterization**
- **completion of 2x8 demo platform**

8x8 Arrays of TES Microcalorimeters with Bi/Cu Absorbers

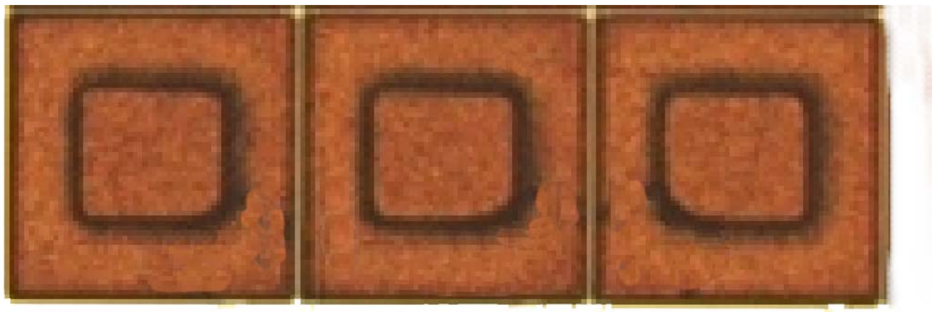
- First 8x8 arrays produced with high-efficiency, high-fill-factor absorbers
- We are able to continue pixel optimization studies (noise mitigation, absorber design) within these arrays
- We are also able to study methods to address heat-sinking and thermal crosstalk

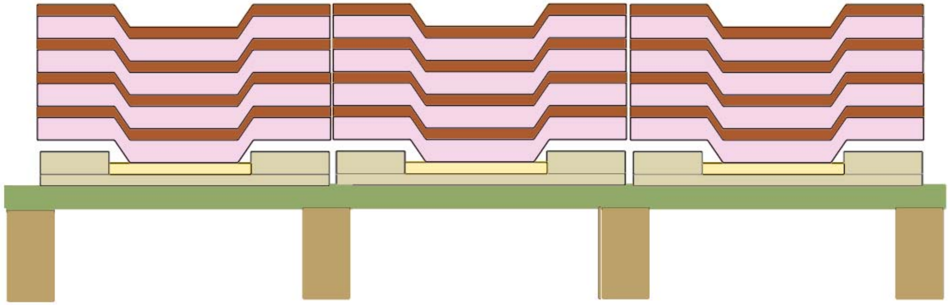


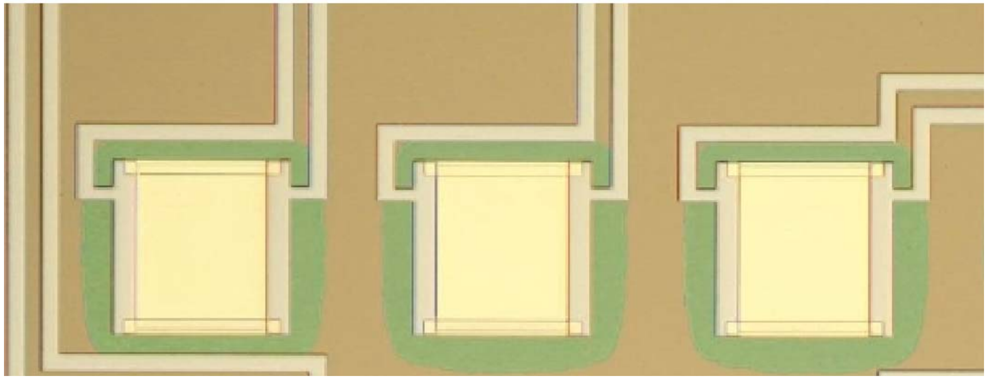

8x8 array
Coil for magnetic field tests
GSFC
NASA/GSFC
TRANSITION-EDGE SENSORS

Compact pixel overview

- **Overhanging absorbers**
  - Layers of Bi and Cu
  - Bi for high absorption efficiency
  - Cu for good thermal conductivity and for tuning the heat capacity
- **TES calorimeters suspended on SiN membranes**
- **Reducing the heat capacity to match a lower α (since lower α associated with lower excess noise) will require using less Cu**
- **Internal thermal fluctuation noise that might result from removing Cu can be mitigated by making the device slower**
- **We will determine the overall optimization with regard to resolution, efficiency, pixel size, and count rate will be determined**

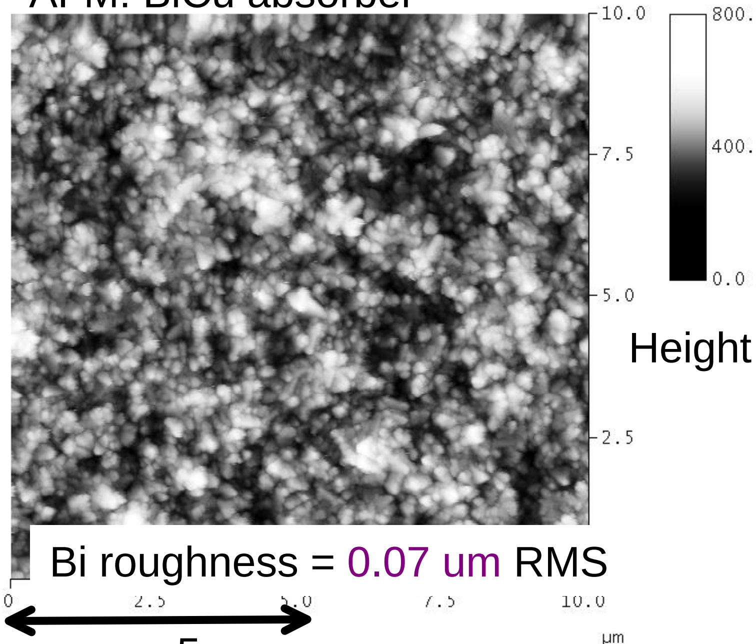






Absorber composition optimization

AFM: BiCu absorber



Bi roughness = 0.07 um RMS

5 um

Performed long series of measurements of R(T) in Bi and Bi/Cu films

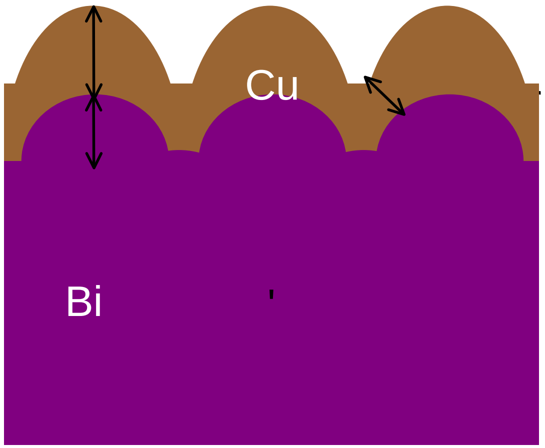
- R(T) predicts thermal conductivity via Wiedemann-Franz law
- will not predict how an x-ray photon thermalizes
- important for optimizing thermal transport once energy is in the electron system
- indicative that a minimum of 0.2 microns of Cu is needed in a Cu layer on Bi to get good transport in the Cu
- consistent with AFM and SEM measurements of Bi roughness

Photo: Bi/Cu strips

2.25 um clumpy | 2.25/0.1um clumpy | 0.1um smooth

Thickness: 0.10um

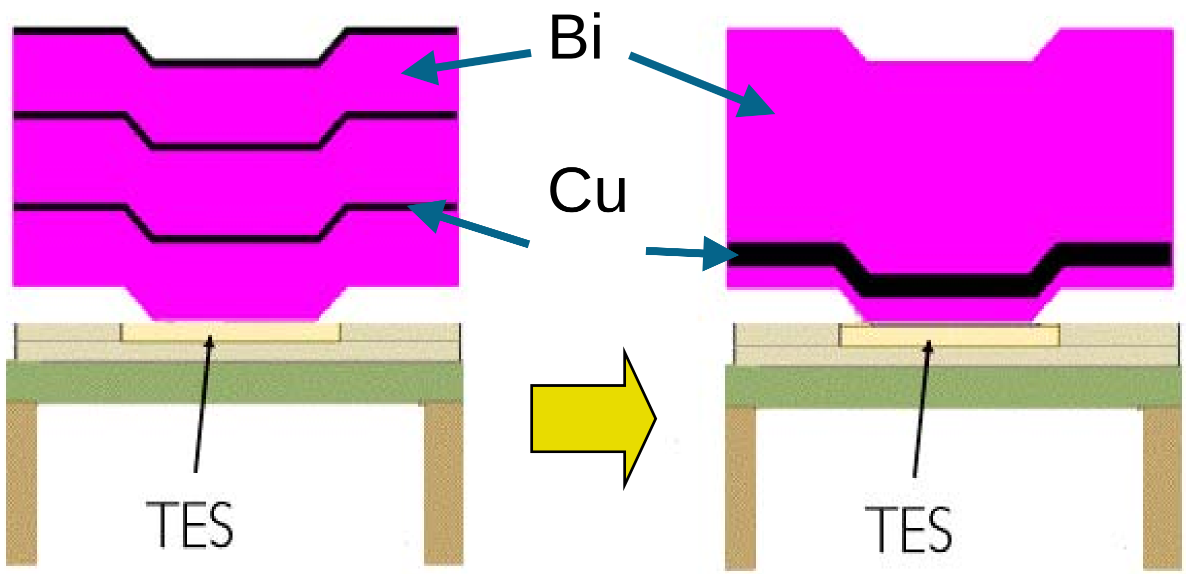
Roughness: 0.07um

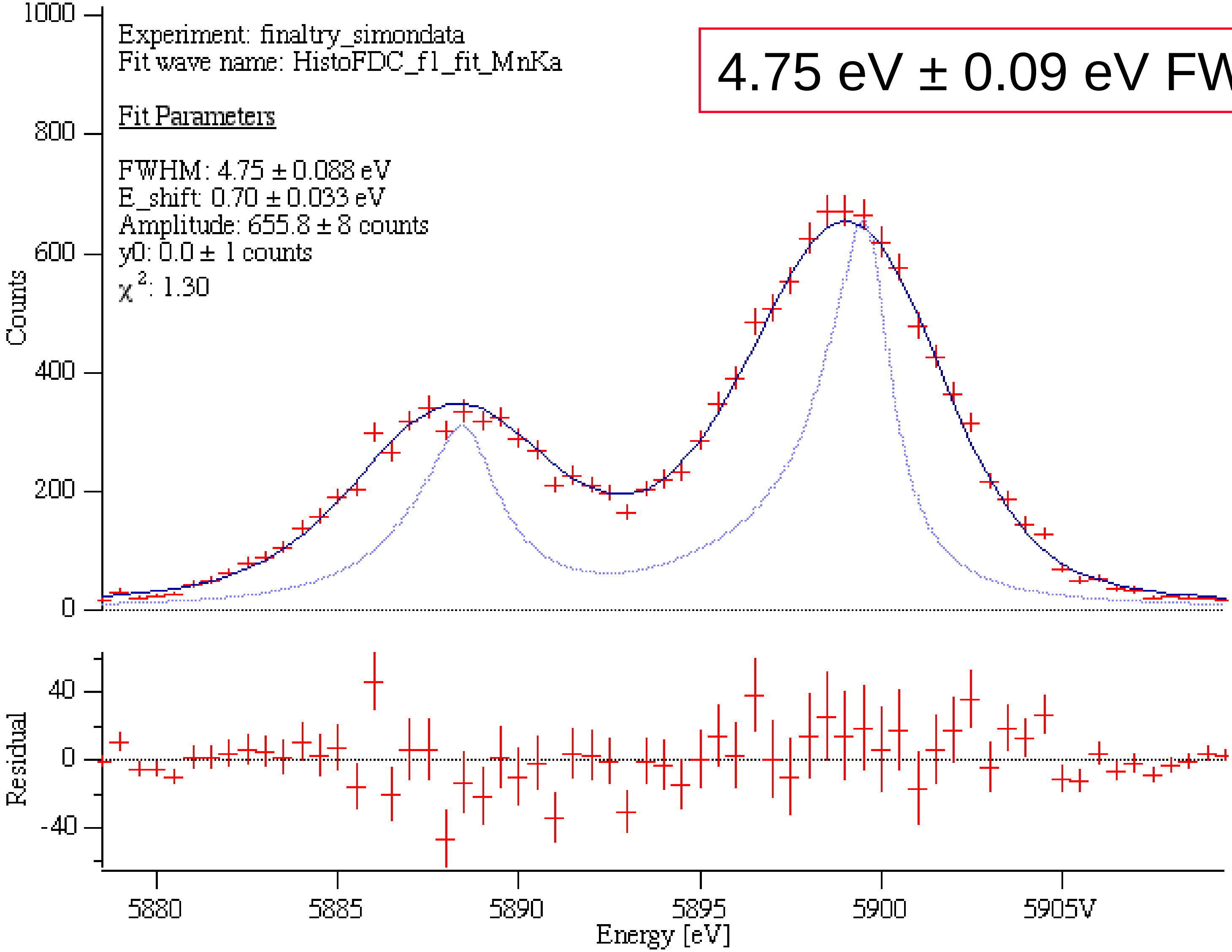


Rough Bi surface makes Cu clumpy.

Absorber optimization

Rearranged the distribution of Bi (6.6 microns total) and Cu (0.6 microns total) to improve thermalization:





4.75 eV ± 0.09 eV FWHM

Example of scaling of time constant and resolution

given reasonable assumptions about noise, sensitivity, and absorber optimization, and a trade-off of time constant and resolution